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ONLINE HACKATHON AS AN INSTRUCTIONAL DESIGN APPROACH TO STUDENT ENGAGEMENT AND INTERNATIONAL COLLABORATION DURING COVID19. A CASE STUDY OF A HACKATHON CHALLENGE AT THE DIGIEDUHACK2021

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Abstract

Despite hackathons having a large potential as an instructional strategy for stimulating student engagement and collaboration in teams, their application as a formal teaching approach and integration into curricula in higher education is less prevalent. This paper reports on applying the format of an online hackathon as a collaborative and inclusive instructional design approach, in which university students from different countries and different academic backgrounds came together for two days to jointly work on solutions in the field of digital education during a hackathon challenge as a sub-event of a larger, European hackathon event. The paper describes the design of the hackathon challenge, its integration into curricula of the university courses, the implementation, the results of in terms of solutions submitted by student teams and the insights from the exploratory study drawing on the observations of the mentors and the results from an online survey with 57 students. The results show that students who participated in the hackathon challenge not only enjoyed the learning experience but also recommended to include online hackathons in higher education as a voluntary activity and as a way to train and find talents. The participants valued the inclusiveness of the hackathon and enjoyed designing new solutions for problems with real-world applications. However, the study revealed some challenges in forming international teams and in collaborating at distance during the hackathon. Therefore, the paper outlines possible design solutions for preparing students for international teamwork during hackathons.

Keywords: Hackathon, student engagement, curriculum, competencies, international teamwork.

1 INTRODUCTION

The COVID19 pandemic has imposed severe limitations both on communication between students and teachers and on international exchanges among students and educators. While instructional designs during the pandemic have explored a diversity of methods going beyond traditional online lectures, including formats such as flipped classroom, co-teaching and problem-based learning, only a few authors so far have reported on applying online hackathons as an instructional design approach to supporting education during the pandemic and beyond. For example [1] reported on an online, educational hackathon during the global pandemic of COVID19 as a method to develop fundamental professional skills of students in software engineering. The key learning results of such an educational hackathon included communication and collaboration skills, initiative, creativity and innovation [1]. The case study by [2] about the virtual hackathon during the COVID-19 pandemic showed how hackathons can be designed as a cooperation between local universities, industry, and government to foster innovation based on digital entrepreneurship. The hackathon EUvsVirus led by the European Innovation Council and described by [3] shows how hackathons can be used during the COVID-19 pandemic to enhance open innovation, leverage distributed knowledge to solve specific problems and develop innovative solutions. These and other examples draw on positive experiences in using hackathons in education before the pandemic. Among others, in 2017 [4] described how a weekend hackathon integrated into a semester-long undergraduate course facilitated inquiry-based learning. Later in 2019, [5] explored differences between curricular and traditional hackathons in the context of higher education and pointed out that there is a shortage of published literature on “curricular” or “formal” hackathons. The report by [6] touches upon the importance of hackathons as an alternative approach for practicing and learning in higher education and highlights key positive aspects of educational hackathons such as peer learning, improvements in problem-solving, project management skills, as well as high levels of engagement and enthusiasm. Despite hackathons having a large potential as an approach to promoting engagement and openness across organizational boundaries, and as an instructional strategy for stimulating student engagement and collaboration in (international) teams, systematic reports on the design and the application of online hackathons in higher education as part of the curricula, especially during COVID-19 pandemic are barely available.

This paper reports on applying the format of an online hackathon as a collaborative and inclusive instructional design approach in the context of higher education, in which university students from different countries and different academic backgrounds came together for a few days to jointly work on innovative solutions in the field of digital education. The online hackathon described in this paper was embedded in a larger hackathon ecosystem and organised as a sub-event (a hackathon challenge) at the DigiEduHack2021[1], an annual series of online, blended and in-person hackathon events, initiated by the European Commission's Digital Education Action Plan. The online hackathon challenge described in this paper was called "Emerging technologies for holistic learning"[2] and aimed at developing innovative solutions using emerging technologies for holistic and engaging learning experiences. The participants in this hackathon challenge were students from universities in different countries worldwide. The key research question addressed in this paper is how to design online hackathons to enhance student engagement and collaboration in international student teams as part of higher educational curricula in contexts such as the COVID19 pandemic. The paper reports on the design of the hackathon challenge and on the results from an exploratory study based on an online survey with 57 students, which evaluated the online hackathon challenge as an instructional approach from the perspective of the participants.

Following this introduction, Section 2 describes the design of the hackathon challenge, including its integration into curricula and the implementation of the challenge during the DigiEduHack2021 event in November 2021. Section 3 presents the results and insights from the online evaluation survey. Section 4 includes conclusions related to the potentials and challenges of online hackathons in the context of higher education. The paper ends with suggestions for integrating hackathons into university courses together with possible areas for future design and research.

2 DESIGN

A hackathon, a compound of "hack" and marathon", is a computing event in which participants collaboratively, intensely and rapidly prototype new solutions over a short period of time, usually one to two days [5]. Hackathons are focused on producing results such as concepts, prototypes or new software/product features, through problem solving and playful experimentation in teams in a limited amount of time [7]. This section describes general design options for hackathons and presents the design considerations for the DigiEduHack2021 hackathon challenge.

2.1 Hackathon design options

When designing a hackathon, there is wide range of diverse design options, themes, methods, formats and audiences to choose from. Some key design options described here provide a foundation for the description of the design of the DigiEduHack2021 hackathon challenge in the next section.

Hackathons have been popular as coding events in the ICT sector and focused on bringing programmers, developers and designers together to collaborate on software projects in a short period of time [8]. Traditionally, hackathons have been used to promote innovation in technology development and/or new uses for existing technology [5]. Over the time, different kinds of hackathons emerged to meet different objectives and cater to the needs of different audiences, e. g. data-dives, code-fests, code-jams, code-camps, hack-days, edit-a-thons, or game-labs. Beside the traditional coding hackathons, which have been largely driven and sponsored by large corporations [5], new forms of non-coding hackathons emerged in recent years. These have included educational hackathons, organised by (public) universities and a diversity of informal (non-curricular) and formal (curricular) hackathon events, which have been designed a form of event-based education, similar to other formats such as BarCamp, World Café or TeachMeet [9].

Moreover, while traditional hackathons take place in dedicated venues and participants remain primarily at these venues with limited breakaways [5], more and more hackathons started taking place online or combine online and onsite into a blended experience, just like the example of the DigiEduHack2021 shows. The comparison of online and onsite hackathons by [7] shows that both formats thrive on spontaneous social interactions between the participants, and that these social interactions can be stimulated both onsite and online. While participants in onsite hackathons report on organisational and schedule-related issues as usual obstacles, participants in online hackathons name working alone at home both as an advantage (e. g. undisturbed work) and an obstacle (e. g. insufficient equipment) to participation [7].

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[1] https://digieduhack.com/en/

[2] https://digieduhack.com/en/berlin-emerging-technologies-for-education

Further design options for hackathons are related to the openness of the event. Hackathons can be designed as closed or open events [5]. While closed hackathons are internal to organizations and focus on a new product (feature) or innovations for a specific company, open hackathons are organized as public or civic events, encourage broad attendance and participation and focus on a specific topic or a technology such as healthcare or wearable devices [5].

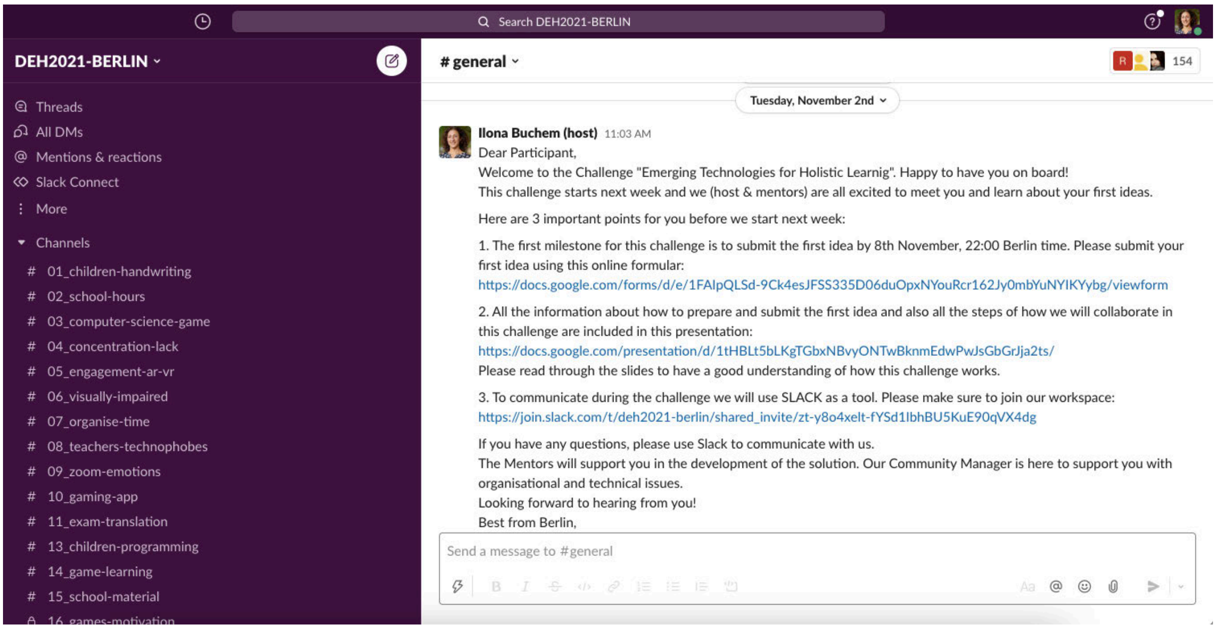
Next, hackathons can be designed as short events spanning one to two days or as extended events. The design of a short, weekend-long hackathon is described in [4]. This example is rooted in the constructivist learning theory and applies the method of inquiry-based learning (IBL) with a problem or task serving as a catalyst for student engagement and participation [4]. The design of an extended hackathon model spanning one to two weeks and integrating the fast-paced, collaborative prototyping and business model development with an innovation curriculum in the field of healthcare innovation is described in [10]. The extended hackathon model consists of three elements – short seminars, field trips to local hospitals, and iterative, hands-on prototyping supported by mentors [10].

Furthermore, hackathons can be designed as stand-alone events or as part of a larger hackathon organisation or ecosystem. An example of hackathons embedded in a larger organisation are the hackathon event “HoloHack 2017” and the GameJam event 2018 hosted at the university-based Learning Factory [9]. An example of the concept of a hackathon ecosystem is provided by [11] and is related to the technology transfer in higher education.

2.2 DigiEduHack hackathon challenge design

Based on the design options listed above, the hackathon challenge “Emerging technologies for holistic learning” described in this paper was designed as a non-coding, short (two days), educational, open, curricular, online event embedded in a larger hackathon ecosystem of the DigiEduHack2021. The hackathon challenge was a non-coding event as it aimed at developing innovative educational concepts for holistic and engaging learning with support of emerging technologies. The envisaged outcomes were neither program codes nor software features, but rapidly prototyped concepts visualised with the help of graphic representations such as diagrams or mock-ups. The event lasted only two days, took place fully online, and was open for all students to participate. At the same time, the hackathon challenge was integrated into the curricula of two courses at the two universities which facilitated the hackathon, i. e. Berlin University of Applied Sciences in Germany and the Academic College Tel Aviv-Yafo in Israel. The integration into the curricula of these two courses was twofold. First, the participation in the hackathon was thematically and organisationally integrated into the curricula, e. g. the topic of the challenge was part of semester projects, kick-off sessions took place during regular class times. Second, participating students received (bonus) points for participation and/or submission which counted for the final grade. In this sense, the hackathon challenge was a blend of an informal (non-curricular) and formal (curricular) approach, depending on whether the participants came from the facilitating universities or from any other higher education organisation.

Altogether over 140 participants from all over the world formed the total of 28 international teams to participate in the hackathon challenge. The participating students had to sign up for the event on the DigiEduHack2021 platform before the event. Since participation was open to all students and students from countries outside Europe, e. g. Kenya and India, joined the challenge and worked in international teams. The hackathon challenge was facilitated by seven persons from altogether six universities, i. e. one host (first author of this paper), five mentors (including the second author of this paper) and one community manager. The role of the host was to set up the challenge and lead the event. The role of the mentors was to support the teams in relation to the content of the challenge and working/collaboration methods in international teams. The role of the community manager was to support the teams in relation to organisational and technical issues. A dedicated workspace in Slack with a channel for each team and for diverse topics was used to streamline communication (cf. Fig.1).



Ilona Buchem (host) 11:03 AM
Dear Participant,
Welcome to the Challenge "Emerging Technologies for Holistic Learnig". Happy to have you on board!
This challenge starts next week and we (host & mentors) are all excited to meet you and learn about your first ideas.

Here are 3 important points for you before we start next week:

1. The first milestone for this challenge is to submit the first idea by 8th November, 22:00 Berlin time. Please submit your first idea using this online formular:
https://docs.google.com/forms/d/e/1FAIpQLSd-9Ck4esJFSS335D06duOpxNYouRcr162Jy0mbYuNYIKYybg/viewform

2. All the information about how to prepare and submit the first idea and also all the steps of how we will collaborate in this challenge are included in this presentation:
https://docs.google.com/presentation/d/1tHBLt5bLKgTGbxNBvyONTwBknmEdwPwJsGbGrJja2ts/
Please read through the slides to have a good understanding of how this challenge works.

3. To communicate during the challenge we will use SLACK as a tool. Please make sure to join our workspace:
https://join.slack.com/t/deh2021-berlin/shared_invite/zt-y8o4xelt-fYSd1lbhBU5KuE90qVX4dg

If you have any questions, please use Slack to communicate with us.
The Mentors will support you in the development of the solution. Our Community Manager is here to support you with organisational and technical issues.
Looking forward to hearing from you!
Best from Berlin,

Figure 1. Screenshot from the DEH20201 challenge Slack showing teams channels.

Additionally live meetings in the web conferencing system Zoom were organised for all participants of the hackathon challenge. Moreover, each team organised their own meetings in Zoom, Google Meeting or WhatsApp and used other tools for collaboration such as Google Drive or prototyping tools such as Microsoft PowerPoint, Axure, Figma.

The challenge started on the day before the official hackathon with the submission of the first idea. To submit the first idea, participants were provided an Idea Building Canvas and the idea was uploaded by participants via an online submission form, created using Google Forms. Submissions had to be made in teams. Based on the initial submissions, the host created channels for each team in Slack. The hackathon challenge started a day later, on the first day of the hackathon, with the morning kick-off session in Zoom. All participants were invited to join the session and at the same time the session took place as a regular class in the course at Berlin University of Applied Sciences. The aim of the kick-off was to provide a short overview of submitted ideas, so that participants, who did not submit any idea could join existing teams. Most of the time during the first day of the hackathon challenge was dedicated to self-organised work in teams. Participants were supported by the facilitators in forming teams, choosing the idea/team to work with, contacting team members, and agreeing on how to work on the solution. To work on the solution, another template –the Solution Canvas – was provided based on the general outline proposed by DigiEduHack2021 organisers for all hackathon challenges. The deadline for submitting final solutions was by the end of the second day 2. The second day started with a new kick-off session in zoom. All teams were invited to attend this session to share their current status, get feedback and ask any questions. The middle part of the second day was again dedicated to self-organised work in teams using the Solution Canvas. The host, the mentors and the community manager supported all teams in working on the final submission. The second day of the challenge ended with a closing session in Zoom which was open to all participants and at the same time took place as a regular class in the course at the Academic College Tel Aviv-Yafo in Israel. The closing session started with a short wrap-up of the two days. Then teams presented their solutions and received feedback. Finally, participants were invited to fill in the online survey in Google Forms. After the closing session in Zoom participants had a few hours time to submit their final solutions to the general DigiEduHack submission system. After the hackathon event, the host and the mentors chose three best solutions and the challenge winners were designated to the DigiEduHack steering group, which had the task to designate 10 to 12 finalists. The finalists from all challenges organised as part of the DigiEduHack are put up for a public vote. The 3 finalists with the most votes receive the DigiEduHack 2021 Global Award, which includes the prize of 5000€ and the status of the DigiEduHack Global Ambassador.

From 28 initial teams, 21 teams submitted a final solution to the DigiEduHack system. The winner of the challenge “Emerging technologies for holistic learning” was the team/solution named “VR & ICT for empathy”[3]. These criteria used by the jury to assess the quality of the challenge solutions included: (a) innovative idea and a meaningful challenge the project is trying to solve, (b) quality of the description of the solution, (c) understanding the needs of end users. All submitted solutions were published on the DigiEduHack challenge website and are publicly available[4].

3 METHOD AND RESULTS

An exploratory study was conducted to evaluate the online hackathon challenge as an instructional design approach. The virtual hackathon was evaluated using a quantitative approach and the data was collected with an online survey. The key research question guiding the study was related to the exploration of a hackathon as a learning environment and its instructional design.

3.1 Study tools

The online survey was designed using the online survey tool SurveyMonkey. The survey included three groups of 35 questions in total: Part I Socio-demographic data (7 questions); Part II Communication (14 questions); Part III Learning Design of the hackathon (14 questions). Items in Part I Socio-demographic data with standard information related to the country of origin, age, gender, education level, field of study, as well as further items related to previous international experiences such as working in international teams, previous experiences in communicating in the English language and previous participation in hackathons. Part II Communication was used to evaluate the learner experience in the hackathon as a learning environment. These items were derived from the User Experience Questionnaire (UEQ), which is an end-user questionnaire to measure user experience in the context of software products [12] and was already adjusted to the context of the hackathon [13]. Items in Part III Learning Design of the hackathon were designed by the authors of this paper to capture perceptions of students related to the specific elements of the instructional design of the hackathon such as the framework, the reason to participate and the collaboration.

3.2 Study sample

Altogether 146 students in 28 groups participated in a two day online hackathon. The online survey was conducted with participating students at the end of the hackathon. The students were given approx. 15 minutes to fill in the questionnaire before the end of the last meeting. 57 students (39%) participated in the online survey. Table 1 gives an overview of the characteristics of the study sample.

Table 1. Characteristics of the study sample (n=57).

Socio-demographic categories	*Study sample*
Country of origin	75.4% Israel (n=43) 19.3% Germany (n=11) 3.5% India (n=2) 1.8% Italy (n=1)
Age	M = 26.7, SD = 5.65
Gender	52.6% female (n=30) 47.4% male (n=27)
Previous experience (1 = very weak, 5 = very strong)	International experience: M=3.00, SD=1.64 English language experience: M=4.53, SD=1.24
Education level	Bachelor students = 49.7% Master students = 35.1% Other = 15.2%
Number of hackathons participated in the past	None - 79% (n=45) One to two - 12.3% (7) Three and more - 8.7% (n=5)

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[3] https://digieduhack.com/en/solutions/vr-ict-for-empathy

[4] https://digieduhack.com/en/year/2021/2021-solutions

3.3 Results from the participants' survey

In this section we describe the results of the online survey with 57 students from Israel, Germany, India and Italy (53% female, 47% male). The data analysis was an exploratory and iterative process. To analyse the survey data, IBM SPSS Statistics software (version 28) was used to code, categorize, and conduct the data analysis.

The number of final submissions can be considered as one of the key outcomes of the hackathon: Out of the organized 28 groups who participated in the hackathon, 21 teams (75%) submitted their final solution and 16 teams (59%) created a prototype such as paper prototype, presentation or an interactive mock-up. When asked "What do you think about the hackathon framework?", 41% of the students positively assessed the duration of the challenge, while 35.9% indicated that the duration of two days was too short (cf. (Fig. 2). 74% of the students stated that the number of participants in their group was enough (M=4.46, SD=3.51). 56.4% felt that the amount and the duration of the joint online Zoom meetings during the hackathon were enough, and 47.37% of students stated that they received just enough support from their mentors.

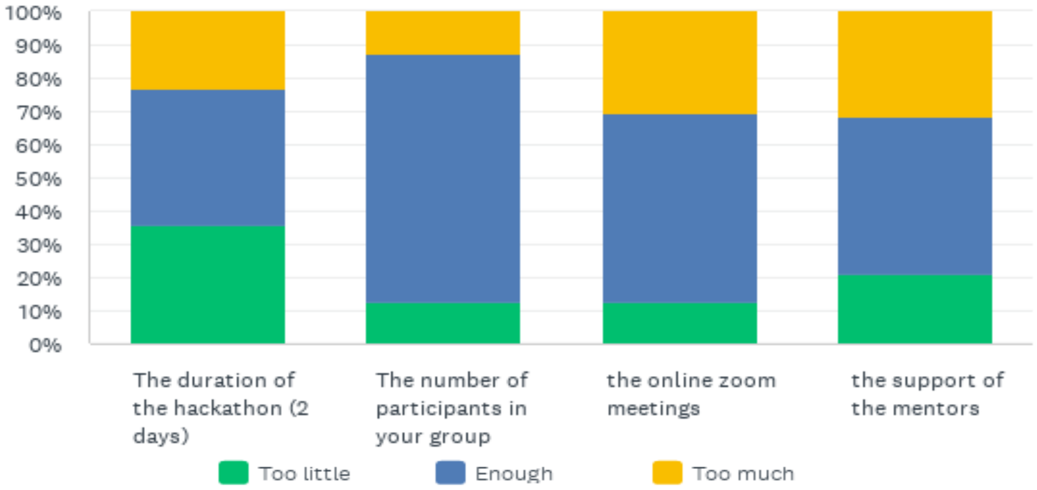

Figure 2. Students' responses to the question "What do you think about the hackathon framework?" (n=39).

When prompted to mark what were the main reasons to attend the hackathon (cf. Table 2), the most common answer was "because I was told to do so by the teacher" (53.85%). Still, 33.33% of the students stated that curiosity to try new things also led them to participate. Almost half of the students (46.15%) said that neither the monetary prize nor developing own ideas or prototypes was a good enough reason to participate (43.59%). Only 25.64% of the students stated that the reason to attend was to improve their knowledge, learn about new tools and contribute to improving education.

Table 2. Reasons to attend the hackathon (n=39).

Reasons to participate	*Not Important*	*Either Way*	*Important*
Because I was told to do so by the teacher	12.82%	33.33%	53.85%
To network and meet new people	38.46%	38.46%	23.08%
To learn about new tools, software and technologies	38.46%	35.90%	25.64%
To contribute to improving education	35.90%	38.46%	25.64%
To do something good for the community	38.46%	38.46%	23.08%
To win the prize	46.15%	30.77%	23.08%
To promote myself	35.90%	41.03%	23.08%
To improve my professional career prospects	35.90%	41.03%	23.08%
Curiosity about trying new things	35.90%	30.77%	33.33%
They're fun!	41.03%	33.33%	25.64%
I like building prototypes of my ideas	43.59%	35.90%	20.51%

The students met online with each other during the two day hackathon a multiple times and communicated directly in international groups. Part II of the online survey was derived from the User Experience Questionnaire (UEQ), an end-user questionnaire used to measure user experience [10]. The items from UEQ were adjusted in wording and number to the context of the hackathon. The adapted UEQ items were fit for purpose and measured learner experience in the learning environment of the hackathon [13]. The highest values were reached for the aspects friendliness (M=5.18, SD=1.47), excitement (M=4.74, SD=1.12) and joy (M=4.66, SD=1.38). The lowest values were reached for the value (of the hackahton experience) (M=3.57, SD=1.65) and clarity (M=4.03, SD=1.58). The results of the descriptive analysis are summarized in Table 3.

Table 3. Communications aspects' descriptive statistics (Scale 1-5 with 1=low, 6=high) (n = 47)

UEQ items	*Mean*	*SD*
Value	3.57	1.65
Motivation	4.32	1.41
Excitement	4.74	1.12
Joy	4.66	1.38
Practicality	4.44	1.31
Interest	4.10	1.57
Friendliness	5.18	1.47
Understanding	4.28	1.82
Ease	4.21	1.70
Clarity	4.03	1.58
Organization	4.40	1.50

When asked whether students would recommend online hackathons in higher education, 56.4% of the students recommended to include hackathons as part of course curricula. However, most students recommended not to include hackathons as a part of course assessment procedures but rather as a voluntary activity without grades or merits (71.8%) and as a way to train and find talents (58.9%).

The students also stated that they enjoyed designing new solutions (56.4%) and working on a problems that have real-world applications (56.4%). When asked "What are the key outcomes from the hackathon for you?", 33.3% of the students ranked "Learning how hackathons work" as the main outcome, while 25.6% of the students ranked "Higher awareness of digital education" as the key outcome.

4 CONCLUSIONS

The key research topic guiding the study was the exploration of an online hackathon as an instructional design approach. The results of the exploratory study show that the design of the hackathon was effective in the sense that 75% of the groups submitted a final solution at the end of the two-day hackathon challenge. This may be due to the structure of the hackathon, which was designed as a short event with clear milestones and templates that supported the creation and the submission of group solutions. Another reason could be the help of the mentors and the satisfaction of the participants with the quantity of the support from the mentors. Other results indicate that the instructional design of the hackathon was also effective in the sense of user experience. Students not only enjoyed the learning experience during the hackathon but also recommended to include online hackathons in higher education as a voluntary activity and as a tool to train and find talents.

Surprisingly enough, it was the first hackathon for most students (79%) although their field of study in information systems and digital business is closely related to the traditional application field of hackathons. Probably, the students were not given the opportunity to participate in a hackathon before but possibly also did not actively look for and participate n a hackathon out of their own interest. Most students indicated that the main reason for participating (54%) was due to a compulsory requirement in the course. This insight indicates that it is even more important to expose the students to the framework of a hackathon early in their studies in order to give students the opportunity to experiment and learn the mechanism and the value of a hackathon. As described by [4], hackathons integrated into a semester-long undergraduate course can be also used to facilitate inquiry-based learning.

As a result of this exploratory study, we formulate several recommendations for the instructional design of hackathons and integrating hackathons into higher education course curricula:

1 First, since online hackathons are an engaging format for collaboration, especially in international settings and in times when travel is not possible, we recommend to include hackathons as an instructional method in study programs. As indicated by [7], online hackathons provide an advantage of flexible participation from home.

2 Second, as far as an instructional design of a hackathon is concerned, we recommend exposing students to the format of a hackathon during their studies as a part of the regular course curriculum, so the students can learn how to face the challenge of remote collaboration in international teams, which may be an important part of there work life at some point in time.

3 Third, from our experience, students are not available for two days of full participation in a hackathon during their semester, due to their other commitments including study and work. Therefore, we recommend stretching the challenge in time for at least two weeks with shorter spans of time per day for team collaboration.

4 Furthermore, we recommend planning an introductory meeting with all students prior to the hackathon, in which students can learn about the hackathon as an event format, about its value for work life, innovation and group collaboration, as well as about examples of successful hackathons from different fields.

5 Finally, to enhance interaction between groups, we recommend creating and using a peer feedback rubrics or score sheet for students to assess the work of their peers. Peer feedback in hackathons can be used in addition to the evaluation of mentors or judges and can possibly enhance involvement and commitment of students.

Following up on the research by [1], possible areas for future research include the exploration of what skills students develop during hackathons (e.g., problem solving, digital skills, collaboration) and how students may apply these skills at their work, e. g. after graduation.

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